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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/712,740	11/13/2003	In Kyu Chun	20059/PIA30957	8888

7590 07/14/2004
GROSSMAN & FLIGHT LLC
Suite 4220
20 North Wacker Drive
Chicago, IL 60606-6357

EXAMINER	
MALSAWMA, LALRINFAMKIM HMAR	
ART UNIT	PAPER NUMBER
2825	

DATE MAILED: 07/14/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/712,740

Applicant(s)

IN KYU CHUN

Examiner

Lex Malsawma

Art Unit

2825

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Nov. 13, 2003 through Feb. 20, 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 November 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Objections

1. Claim 1 is objected to because of the following informalities:

At claim 1, lines 8 and 9, “the damascene pattern” should be changed to “the dual damascene pattern” in order to avoid any lack of antecedent basis.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Modak** (6,537,913 B2) in view of **Liu** (6,211,085 B1).

Regarding claim 1:

Modak discloses a method of forming a Cu line in semiconductor fabrication, comprising:

forming a dual damascene pattern (Fig. 1a) by etching a PMD 101 layer formed on a substrate 100, wherein the dual damascene pattern includes a contact hole portion 103 located on the substrate and a trench portion 104 located on the contact hole portion, the width of the contact hole portion being narrower than that of the trench portion;

depositing a “first” diffusion barrier 106 (Fig. 1b and Col. 3, lines 4-6) on sidewalls of the dual damascene pattern;

filling the dual damascene pattern with “a first metal” 105 (copper) by depositing the first metal on the first diffusion barrier to form a first metal layer;

chemical mechanical polishing a portion of the first metal layer 105 over the trench portion (Col. 3, lines 23-26);

etching the upper part of the first metal layer in the trench portion to form a first-metal plug 111 (Fig. 1c and Col. 4, lines 10-14) that occupies a lower part of the first metal layer in the trench portion and the contact hole portion (Fig. 1c);

depositing a second diffusion barrier 107 on the first-metal plug 111 Fig. 1d; and

depositing a second metal 108 on the second metal diffusion barrier 107 (Fig. 1d).

Modak **lacks** the “first metal layer 105” being tungsten and the “second metal layer 108” being copper. However, it is important to note that Modak discloses the essential process steps/sequence of the current claim; and the only essential difference between the Modak and the current invention seems to be in preferred materials for the first and second metal layers. Liu is **cited primarily to show** it was very well known in the art that a dual-damascene-contact structure can be formed by specifically incorporating tungsten and copper, wherein tungsten is used to fill a contact hole portion (i.e., used as a first metal layer) and copper is used to fill the trench portion of the dual-damascene-contact structure (i.e., the copper is used as a second metal layer). Given that Modak discloses the essential process steps of the claimed invention and that Liu shows that the specific materials (W and Cu) recited in the claimed invention were very well known and used in dual-damascene-contact structure, it would have been obvious to one of

ordinary skill in the art to modify Modak by specifically utilizing the materials specified by Liu, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter obvious design choice. *In re Leshin*, 125 USPQ 416.

4. Claims 2-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Modak** (in view of **Liu**) as applied to claim 1 above, and further in view of Huang et al. (5,527,736; hereinafter, “**Huang**”).

Regarding claim 2:

Modak (in view of Liu) **lacks** performing dry-etching process on the first metal layer 105; however, it is noted that Modak specifies a wet-etching process is used primarily because the first metal layer is specifically copper (Col. 4, lines 10-14). Huang **teaches** that it is conventional in the art to utilize dry etching when forming a recessed tungsten plug 24 within a contact hole (note Figs. 2, 5, Col. 1, lines 31-33; and Col. 2, lines 57-60). Given that Modak (in view of Liu) incorporates a tungsten layer to provide a tungsten plug, it would have been obvious to one of ordinary skill in the art to specify a dry-etching process performed on the tungsten layer (of Modak in view of Liu) because Huang teaches that it was conventional in the art to etch tungsten by dry etching.

Regarding claims 3 and 4:

Modak discloses the first diffusion barrier 106 includes titanium nitride and the second diffusion barrier layer 107 includes tantalum nitride (Col. 3, lines 4-6 and Col. 4, lines 25-28).

Regarding claims 5 and 6:

The cited references disclose the claimed invention except for specific ranges for height and diameter for the dual damascene contact structure. It would have been obvious to one of ordinary skill in the art to specify ranges as currently claimed because a specific range would depend on a particular design (or design requirement), and it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The references listed on the attached Form PTO-892 are cited to show method of forming dual damascene contacts utilizing process steps and materials similar to those of the current invention.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lex Malsawma whose telephone number is 571-272-1903. The examiner can normally be reached on Mon-Thu (1 PM - 9:30PM EST) and Sat.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on 571-272-1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Art Unit: 2825

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Lex Malsawma



July 12, 2004



MATTHEW SMITH
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800